The evaluation of effect of coco peat and bagasse on *Coriandrum sativum* seed germination

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Abstract

Mulching using agricultural leftovers prevents excessive evaporation of surface water on the soil. However, agricultural residuals must be used to cover the entire crop canopy and a large quantity of this material is required for mulching. There is a pressing need to find a low-cost biodegradable material that is easy to mix with soil and has a high water retention capacity. The use of environmentally friendly absorbents like bagasse and coco peat in specific proportions has been shown to maintain soil moisture retention capacity.

To evaluate water absorbency, evaporation rate and growth rate of coriander seeds, batch absorption experiments were conducted in both the summer and rainy seasons. The experiment used a bed of soil, a combination bed of soil-bagasse and a combined bed of soil-coco peat with known volumes of these components. Fibrous bagasse has been shown to be an effective absorbent and material with a high water retention capacity. Bagasse can be utilised as a substitute for coco peat to reduce soil evaporation and soil amendment, according to the experimental results acquired from the aforementioned test procedures.

Keywords: Bagasse, coco peat, evaporation rate, seed germination, eco-friendly absorbent.

Introduction

One of the most essential variables in the development of agricultural areas is water resources. In dry and semiarid settings, the balance of water resources and soil water evaporation are critical for crop growth. During a typical growing season, it is estimated that more than half of the total soil water evaporates.[5,9] The evaporation of soil water is influenced by a variety of elements including soil qualities, ground water level, irrigation method and metrological circumstances. Soil degradation and desertification of fertile land are global issues caused by the loss of organic matter nutrients and excessive moisture evaporation in the soil.[9] These are the results of poor land and soil management. Because of competing non-agricultural uses, the net amount of land accessible for agriculture is steadily decreasing.

India occupies only 2.4 percent of the world's total land area but it houses 17.7 percent of the world's population. The demand for food, clean air and clean water is growing. Soil deterioration is caused by both natural and human-made processes. Nutrient mining occurs as a result of excessive ploughing and the exploitation of crop wastes as fodder and fuel. Crop residue burning pollutes the environment by producing greenhouse gases. As a result, important steps must be done to link water cycle, carbon, nitrogen and phosphorus fixation and watershed scale to improve the provision of vital ecosystem services from agro-ecosystems like food, fibre, fuel and water biodiversity. More agro-economic yield per unit area, water, energy and fertiliser input are some of the solutions that should be implemented for long-term agro-system mitigation. Best management methods such as afforestation of degraded soil, restoration and maintenance can be used to implement these strategies.

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Best management methods such as afforestation of degraded soil, restoration and maintenance can be used to implement these strategies. Mulch farming may be used in conjunction with agriculture.[6]

In arid and semiarid locations, there is a considerable requirement to limit soil water evaporation in order to quantify water availability and manage water resources.[5,9] Moisture in the soil is important for managing the nutrient cycle, which has an impact on land evaporation and helps to keep the water energy and carbon cycle in balance.[2] It has been discovered that by mulching soil with crop leftovers, soil water evaporation can be regulated to a large extent. Crop leftovers conserve water by reducing soil evaporation, which is especially important in early crop stages with a modest crop canopy.

During crop growth, the influence of crop residue on evaporation rate suppression decreases as the crop canopy grows. After decomposition, these residues increase soil quality by contributing nutrients.[4] Crop residues are a viable option for minimising soli water evaporation and maintaining the ecological and physical balance of agricultural land. However, mulch decomposes during crop growth; therefore, the effect of evaporation suppression later in the crop season may be predicted to diminish as the crop canopy grows. As a result, a different approach is needed to manage the rate of water evaporation in the soil and keep it moist. Improved physical and chemical qualities, as well as increased biological activity, are all indicators of high organic matter concentration in soil.[1,5]

Mixing in a sufficient amount of environmentally friendly water-holding material in the soil may be an effective way to reduce evaporation rates. Coco peat is a cellulose-based substance made from coconut leftovers that has a high capacity for absorbing water. It is a staple of Indian agriculture. It is usually mixed into the soil before planting crops that requires a lot of water.[8] Bagasse, on the other hand, is a fibrous residue that remains after the juice has been extracted from sugarcane and is high in carbon[3,7]. These two bio-absorbents were blended in soil and the rate of seed germination was measured in this research.

The rate of evaporation is affected by the weather. It is extremely hot throughout the months of March, April and May, with temperatures ranging from 30 to 40^{0}C. The rate of evaporation is lower during the rainy season since the temperature ranges from 25 to 30^{0}C. Water absorbing capacity, water holding capacity and rate of evaporation of soil, bagasse and coco peat were all assessed as a result. In addition, the current study evaluated seed growth rates in various materials including soil, the specific composition of soil-coco peat beds, soil-bagasse beds and soil-bagasse-coco peat beds.

Material and Methods

Coir pith was received from a local coir pith processing machine while bagasse was procured from a neighbouring sugar factory for the experimental work. Fertile soil was taken from the farm and the moisture was removed by drying the three ingredients in an oven at 105^{0}C. Chemical testing of the obtained soil was done in a private laboratory run by Vanita Agro-tech while physical testing of the material was done using the following procedures.

Capacity to absorb water: 50 grams of dry material were divided into three containers, each with a small hole at the bottom. Each container received a known volume of water that was gradually poured until the stuff within became entirely moist and the water drains from the opening at the bottom of the container. Each material's water absorption volume was measured.

Water evaporation rate: The rate of material evaporation was calculated using the volume of material exposed to sunlight. An equal volume of material was placed in each tray along with the amount of water required to completely moisten the material. The trays holding the substance containing the most water were exposed to the sun for 24 hours. The amount of moisture left after evaporation was computed and expressed as a percentage. Three distinct beds of materials were made to test the rate of evaporation. Trays containing an equal volume of soil, bagasse and coco peat were filled with the appropriate amount of water to completely soak the materials. The initial weight was reported as the weight of wet material.

The trays were exposed to sunlight for the desired amount of time. During the exposure of material to sunlight, the temperature ranged from 35 to 40^{0}C. The weight of the substance in each tray was recorded once more and the weight loss after evaporation was calculated. The rate of evaporation was calculated using the formula:

$$\% \text{ Rate of evaporation} = \frac{\text{Weightofwaterremainingafterevaporation}}{\text{weightgainofmaterialduetoabsorbedwater}} * 100$$

Similarly, when the temperature range was 25 to 30^{0}C, the rate of evaporation was calculated.

Seed germination rate: Three different trays measuring 27 cm in length, 22 cm in width and 4 cm in height were used to determine the rate of seed germination. The first tray was labelled tray A and was filled with soil. The second tray, labelled tray B, was filled with 40 parts bagasse and remaining soil by total volume of the tray. The third tray, labelled tray C, was filled with 40 parts coco peat and the rest portion of soil by total volume of the tray. Each tray included 6 gram of coriander seeds. Every day, depending on the amount of moisture left in the material in each tray, the appropriate amount of water was sprayed. A set number of days were set aside for testing.

Root and shoot lengths: Root and shoot lengths of randomly germinated *Coriandrum sativum* plants in each tray were measured and averaged.

Results and Discussion

The soil utilised for the experiment had lower levels of organic carbon, nitrogen and phosphorus according to the test results. It has a sufficient amount of potassium.

In comparison to bagasse and coco peat, there is a significant difference in the volume of water absorbed and held by similar weight of soil in the table. The volume of water absorbed by bagasse and coco peat is similar, but the rate of evaporation is 16 percent higher in the case of bagasse than in the case of coco peat. In soil, the percent rate of evaporation was found to be greater.

Rate of sprouting: In the summer, the rate of seed germination was found to be highest in a bagasse-soil mixture. However, during the wet season, the rates of seed germination for soil, bagasse-soil and coco peat-soil mixtures do not differ significantly. In comparison to soil – bagasse and coco peat-soil mixtures, the number of

Coriandrum sativum seeds germinated in soil was higher at first, but after 18 days, more seeds germinated in soil – bagasse mixture.

The root length of *Coriandrum sativum* plants cultivated in soil, bagasse and coco peat-soil mixtures was all the same, however the shoot length of plants grown in the coco peat-soil mixture was the longest after 18 days.

Table 1
Chemical analysis of soil

S. N.	Parameters	Result
1	pH	8.69
2	Electric conductivity	0.21 dS/m
3	Organic carbon	0.70%
4	Nitrogen	60 ppm
5	Phosphorus	6 ppm
6	Potassium	127 ppm

Table 2
Water absorbing capacity

S.N.	Material	Volume of water absorbed
1	Soil	16.66 ml
2	Bagasse	300 ml
3	Coco peat	250 ml

Weight of Material = 50 gram each

Table 3
Rate of evaporation

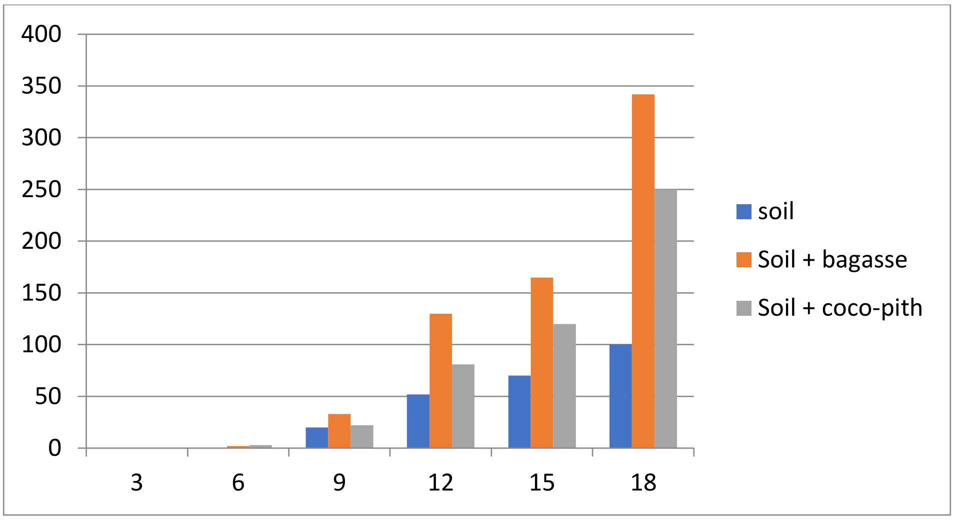
Material	Weight of material for given volume (in gram)	Weight of material + water required for wetting (in gram)	Weight gain of material due to water (in gram)	Weight of material remaining after drying (in gram)	Weight of water remaining after evaporation (in gram)	% Water remaining after evaporation	% Rate of evaporation
Bagasse	270	1028	758	468	198	26	74
Soil	1706	2278	572	1750	44	7.69	92.31
Coco peat	277	1032	554	510	233	42.05	57.95

Table 4
Number of Seeds Germination in Summer

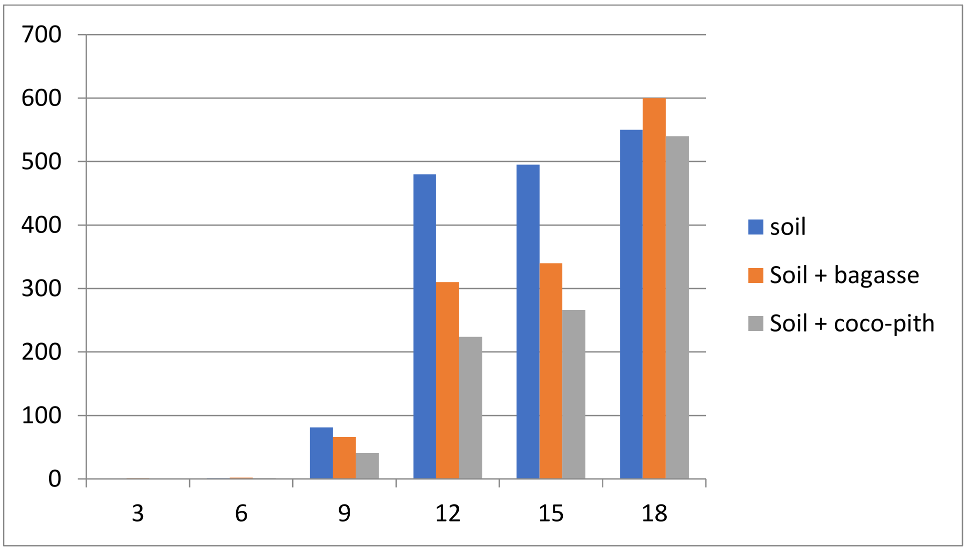
Number of days	Soil	Soil + bagasse	Soil + coco peat
3	0	0	0
6	0	2	3
9	20	33	22
12	52	130	81
15	70	165	120
18	100	342	250

Table 5
Root and Shoot Length

	Root length in cm	Shoot length in cm
Soil	4.0	10
Soil and bagasse	4.0	11.1
Soil and coco peat	4.0	12.5



Graph 1: Number of seeds germinated against time



Graph 2: Number of seeds germinated against time

Seed germination in bagasse **Seed germination in soil** **Seed germination in coco peat**

Fig. 1: Seed Germination

Conclusion

1. Dry bagasse has a higher water absorbing capacity than coco peat, but coco peat has a higher water holding capacity since more than half of the water remained in the material after drying in the sun at 35^0C.

2. Mill bagasse can be used as a substitute for coco peat since it can absorb and contain a similar quantity of water, assisting in the germination of *Coriandrum sativum* seeds, particularly in dry climates.

3. Organic carbon can be enhanced by mixing fibrous crop leftovers, resulting in increased shoot length of *Coriandrum sativum* seed after germination.

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